

# **The Influence of Sound Exposure Onset and Duration to the Hearing Loss Prevalence in Musicians**

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## **Abstract**

Musicians are often exposed to loud music during practice playing their instrument or performance on stage, so they are at risk of permanent cochlear nerve damage or hearing loss. However, the risk of hearing loss is not well understood since there is a significant inter-individual variation in susceptibility and degree of hearing loss. Hearing properly is vital for musicians for hear the right notes and words to playing in the correct pitch and key. Since it is not often possible to avoid the noise exposure, some changes of risk factors and use hearing protection devices are suggestion for preventing of hearing loss. Study aims were to determine the influence of sound exposure onset and duration to the hearing loss prevalence in musicians. This study was an observational analytic study using a cross sectional design conducted on 35 among musicians in Yogyakarta City Indonesia during October 2019 - February 2020. We collected demographic data, type of instruments, onset and duration exposure, complaints about hearing and the used of protective device. All participants underwent ear clinical examination and pure tone audiometry interpreted by an audiology consultant. The data obtained were described by frequency and percentage and compared ratio analysed using chi-square test. The prevalence of noise induced hearing loss in musicians at this study was 20%, an audiometric notch in one or both ears were found in 5.71 % and 14.29 % of the participants, respectively. The main complaint was tinnitus reported by 21 (60%) and only 2 (5.71%) of the participants wore hearing protection. Bivariate analysis using chi-square test between the sound exposure onset with hearing loss prevalence obtained p value of 0.578 ( $p > 0.05$ ), and between the sound exposure duration weekly with hearing loss prevalence obtained p value of 0.02 ( $p < 0.05$ ). The sound exposure onset is not significantly influence to the hearing loss prevalence, while the weekly sound exposure duration is significantly influence to hearing loss prevalence in musicians. Since lack of knowledge and awareness most musicians never used protective devices.

## **Keywords**

Hearing loss, sound exposure, onset and duration, musician and prevention.

## **1. Introduction**

Professional musicians dedicate years of their lives to intense practice in order to be able to play music at a professional level. Stressful factors include a lack of stability in one's finances and profession, frequent competitions, and performance-related obligations (Niarchou et al. 2021). In addition, the physical demands of high-level performance make one more susceptible to physical ailments. This environment plays a significant role in the frequency of overuse injuries in instrumental players (Berezutsky 2020). According to previous research that reported the diseases complaint by musicians were for musculoskeletal issues, health behavioral issues, and nervous system disorders including hearing loss (Elam et. al. 2022).

Musicians are at risk of hearing problems due to prolonged exposure to high level of noise on perform and practice music on a regular basis. Following oxidative stress, metabolic depletion, and ischemia, persistent exposure to noise gradually destroys the cochlea's inner and outer hair cells. They are more likely to experience tinnitus, hyperacusis, and diplacusis as well as hearing loss (Stadio A 2018). Tinnitus and hearing loss can have a negative effect on the lives of professional musicians that caused their career may be ended by such of these conditions. To prevent the incident healthcare providers must help treating them for management regulations for safe levels of noise exposure, prevention, and health education to used hearing protectors (Santoni and Fiorini, 2010).

Musicians are frequently disregarded when it comes to workplace safety and health procedures, despite the fact that there are occupational norms and standards designed to prevent people who work in extremely noisy situations from developing noise-induced hearing loss (NIOSH, 2015). This is particularly true for amateur musicians who might not even think they are at risk for NIHL. The majority of musicians lack sufficient understanding about hearing conservation and as a result, they never utilize ear protective to prevent NIHL or do not wear hearing protection (Dinakaran 2018). Furthermore, musicians only use hearing protection on rare occasions, mainly because they find it difficult to perform optimally when wearing hearing protection (Santoni and Fiorini, 2010).

### **1.1 Objectives**

The research objectives were to determine risk factors of hearing loss prevalence among musicians, including the sound exposure onset and duration, type of instrument, awareness about hearing protection by using hearing protection device.

## **2. Literature Review**

Professional musicians face a special set of health risks and pressures as part of their line of work. According to reports, musician groups experience different health problems than comparable sample national communities. Professional musicians dedicate years of their lives to intense practice in order to be able to play music at a professional level, which frequently require for precise and repeated motions. This condition plays a significant role in the frequency of overuse injuries in instrumental players and indicate a variety of physical health problems (Elam T et al. 2022). Some diseases associated with being a musician including musculoskeletal problems, cardiorespiratory problems, skin disorders and hearing loss. Competitive evaluations, performance demands, lack of career stability and financial security can be sources of mental problems that also common among musicians related to anxiety, depression, sleep disorders, alcohol dependent and drug abuse (Niarchou et al. 2021).

It is generally accepted that exposure to sound above 80 dB after long period can cause permanent damage to the cochlear nerves. Despite hearing conservation programs was implementation over recent decades, NIHL continues to occur in industrial settings including entertainment/music industry. Musicians are at risk for hearing loss due to exposure of levels beyond 85 dBA, either in the sound level produced by single musical instruments or by the orchestra, have been proven by sound exposure measures in players (Comeau G et al. 2018). Different from most in industries occupational that noise is an unwanted product of the technological processes, the entertainment industry "noise" is the desired product but also constitute a category of employees risk of developing occupational hearing loss (Basner 2015). High sound pressure levels (SPLs) generated by music, however, may also be damaging to hearing (Schmidt 2011).

One of the most common causes of sensorineural hearing loss is noise-induced hearing loss (NIHL). This type of hearing loss is irrevocable, permanent, but preventable. A deeper comprehension of the underlying exposure variables is necessary for the prevention of NIHL in musicians (Rajeh 2022).

To succeed in their field of work, professional musicians frequently rely on having and keeping good hearing health. If happen hearing loss to the musicians, it affects their abilities to perform and limits employment opportunities, as well as affecting general quality of life. To avoid tinnitus and promote hearing health among musicians, there is a need for specialized self-help groups, awareness raising, and education (Dinakaran T 2018).

There is still space for improvement in terms of uptake despite the fact that few professional musicians reported using HPDs at any point throughout their careers. It is also unclear how frequently artists utilize HPDs. Musicians frequently cite the negative effects of HPDs on music perception and performance, problems with comfort and fit, and the notion that HPDs are unnecessary as reasons for not using HPDs (Couth et al. 2022).

### 3. Methods

We conducted a cross-sectional study at many musicians groups with at least five years of professional work experience in Yogyakarta, Indonesia. The investigation involved 35 musicians of all genre music, aged 18–50 years (though not the geriatric age), and consisted of 35 males and no one females. The only inclusion criterion was having at least five years of experience as a professional musician. Musicians with systematic diseases, a history of skull base fractures, long-term use of ototoxic medications were excluded.

Demographic data were collected using questionnaire contain of general information such as: age, gender, auditory complaints, using personal protective devices, and history of previous disease and taking medicine. Occupational exposures and experiences (the duration of playing musical instruments, the number of hours of playing music per week, history of exposure to other risk factors for hearing loss) were added. Clinical examination, the hearing threshold level of the participants was determined in both ears at frequencies of 250, 500, 1,000, 2,000, 3,000, 4,000, 6,000, and 8,000 Hz in the private audiometry clinic.

All statistical analyses were performed using SPSS, frequency and percentage values were used to analyze qualitative variables. Chi-square were applied to compare ratios, values less than 0.05 were considered significant.

### 4. Data Collection

Audiogram from pure tone audiometry examination interpreted by an audiology consultant and decided into normal, conductive hearing loss, sensori neural hearing loss or mixed hearing loss.

### 5. Results and Discussion

Occupational noise exposure is one of the most prevalent environmental and occupational hazards that may be affecting one-third of the global population. Environmental noise pollution above 70 dB increased the risk of noise-related health problems both auditory and nonauditory health. Musicians are also exposed to potentially harmful sound most often while rehearsing, practicing alone, and participating in other musical activities.

#### 5.1 Numerical Results

The characteristics of musicians in Yogyakarta city Indonesia there were dominant of male gender with productive age 21-40 years old (Table 1) Most musicians have side jobs and the rehearsal playing music less than 6 hours per week as hobbies.

Table 1. Respondent Profiles

Characteristics		Frequency	Percentage
Gender	Female	0	0.0%
	male	35	100%
Age	<21	4	11.4%
	21-40	19	45.3%
	>40	12	34.3%
Another exposure	Music concert	5	14.3%
	Earphone used	8	22.8%
	Motor Racing	1	02.8%
	Living area	3	08.6%

	Working area	7	20.0%
	None	11	31.5%

Both recreational and professional music can cause hearing loss as well as other audiological symptoms as tinnitus, hyperacusis, and diplacusis (Di Stadio A 2018). There were different musical genres, such as Pop/Rock or classical music, include varying levels of noise exposure, which in turn depend on a variety of elements, such as the kind and number of instruments used, as well as the volume of the sound produced, but in our study the most genre was popular music (Table 2).

Table 2. Characteristic of Music Exposure

Characteristics		Frequency	Percentage
Instrument type	Bass	3	08.6%
	Guitar	11	31.4%
	Drum	5	14.3%
	Keyboard	12	34.3%
	Snare drum/ Timpani	2	05.7%
	Vocal	2	05.7%
Genre	Pop	24	68.6%
	Jazz	1	02.8%
	Blues	1	02.8%
	Traditional music	9	25.8%
Onset of exposure	1-5 years	8	22.8%
	6-10 years	13	37.2%
	>10 years	14	40.0%
Duration of exposure / weeks	< 6 hours	25	71.4%
	6-12 hours	7	20.0%
	>12 hours	3	08.6%
Used Hearing Protection	Yes	2	05.7%
	No	33	94.3%

In our study, most of musicians not wearing ear protection (94.3%) Table 2, the low of using ear protection equipment shows an indifference to the risk of hearing nerves damage due to noise exposure. This finding similar with previous report that the majority of marching band participants expressed little worry about the health impacts of increased sound exposure and little use of hearing protection devices (Washnik et al. 2021). Pouryaghoub (2017) also report that less than 2% of the participants musicians used hearing protection devices. Couth et al. (2022) identified the barriers of hearing protection used in early-career musicians, include the impact of hearing devices protection on listening to music and performing, and a lack of concern about noise exposure.

## 5.2 Hearing Loss Prevalence Results in Musician

Overall prevalence of hearing loss in musician population at our study (CHL and NIHL) was 57.1% (Table 3). This result higher from hearing loss prevalence of common population in France volunteer 29% (Lisan Q, 2022) and hearing loss prevalence 20.3% in the adults population reported from the Global Burden of Disease Study 2019 surveys from 1990 to 2019 (Vos, 2021). This finding consistent with systematic review conclusion that hearing loss is common in professional musicians (38.6%), affected mainly frequencies in the 3000–6000 Hz range and musician Rock genre type are at higher risk of developing hearing impairment compared to classic genre musicians (Di Stadio, 2018).

Table 3. Hearing Assessment Result from Audiometry Examination of Musicians

Category	Frequency	Percentage
Normal	15	42.9%
CHL	13	37.1%
NIHL	7	20.0%
Total	35	100.0%

The results do not show any increased incidence of hearing loss among university music students as compared to a control group. However this does not imply that music students are not at risk of hearing loss. It is possible that the measurement tools were not sufficiently sensitive to detect early stages of hearing loss or that the effect of the exposure to music instrument playing will manifest itself a few years later (Comeau G, et al, 2018).

### 5.3 The Influence of Sound Exposure Onset and Duration to Noise Induce Hearing Loss Prevalence

The longest sound exposure more than 10 years showed highest prevalence of noise induced hearing loss ( Table 4) but there was no significant difference ( $p=0.578$ ). Noise-induced hearing loss resulting from music exposure has been documented among entertainment or music industry, professional musicians (Pouryaghoub 2017), traditional musicians (Rajehi 2021), university music student (Comeau 2018), university marching band (Washnik et al. 2021),

Table 4. The Influence of Onset of Sound Exposure to Hearing Loss Prevalence in Musicians

Onset	NIHL		No NIHL		Total		P value
	N	%	N	%	N	%	
1-5 years	1	12,5	7	87,5	8	100	0,578
6-10 years	2	15,4	11	84,6	13	100	
> 10 years	4	28,6	10	71,4	14	100	
Total	7	20	28	80	35	100	

The significant influence of duration sound exposure to high prevalence of noise induce hearing loss in this study ( Table 5) differs from Ramma (2021) that concluded a low prevalence of hearing loss among Cape Town Minstrel Carnival musicians, but although only 2.3 % participants presented with sensorineural hearing loss mostly of the reported tinnitus symptom. Similar study reported by Lüders et al. (2014) there was no significant difference hearing threshold for the frequency of 6000Hz in undergraduate music students compared with non-musical student, but the mean pure tone air-conduction thresholds found in undergraduate music students at that frequency in both ears were worse.

Table 5. The Influence of Duration of Sound Exposure to Hearing Loss Prevalence in Musicians

Duration Hours/week	NIHL		No NIHL		Total		P value
	N	%	N	%	N	%	
< 6	3	12	22	88	25	100	0,02
6-12	4	57,1	3	42,9	7	100	
> 12	0	0	3	100	3	100	
Total	7	20	28	80	35	100	

Although the audiometric findings within the normal range musicians did not rule out possible early cochlear damage, its can explain by early sub-clinical hearing damage, such as cochlear synaptopathy. The mechanism were highest levels of noise exposure had reduced outer hair cell function, associated with a significant increase in ABR wave V latency, and a higher prevalence and severity of hyperacusis (Couth et al. 2020).

Steps that can be taken to reduce the bad impact of health musicians as following:

1. Calculate the maximum safe practice time and comprehensive protocol for each instrument to prevent hearing loss in musicians (Rajehi 2021).
2. Taking timed breaks during their practice sessions, the pomodoro technique found using this work/break pattern has improved performance of students and programmers, and the authors believe this is a reasonable framework to provide musicians during their practice sessions (Elam T 2022).
3. Providing education on the importance of hearing protection to reduce tinnitus and hearing loss during periodic health assessments may prevent long term hearing loss in musicians (Burns-O'Connell 2021). Engaging with audiology colleagues to find the best ear protection material that can reduce the effects of sound intensity across many frequencies equally may also help with increasing the use of hearing protection (Dinakaran 2018).

## 6. Conclusion

The sound exposure onset is not significantly influence to the hearing loss prevalence, while the hours of weekly sound exposure duration is significantly influence to hearing loss prevalence in musicians. Musicians exposed to high levels of sound but low levels of care for their hearing health, it's caused a highlight the need for extensive hearing conservation programs for this group.

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